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Information Science and Technology Center UQ Series

Clint Scovel
Los Alamos National Laboratory

"Hypothesis Testing for Validation and Certification"

Tuesday, November 30, 2010
3:30 - 4:30 PM
TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)

"Optimal Uncertainty Quantification"

Thursday, December 2, 2010
10:00 - 11:00 AM
TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)

I will be presenting two talks that develop Uncertainty Quantification and describe their explicit CoDesign nature. In the first talk I will present rigorous results on validation and certification, and in the second a general framework for UQ which permits a notion of Optimal Uncertainty Quantification. In this setting the first talk can be viewed as suboptimal results on validation and certification.

The CoDesign OUQ framework takes full advantage of cooperation among the customer, domain experts, modeling experts, statisticians, applied mathematicians, optimization theorists, and computer scientists.

Talk 1) ***Hypothesis Testing for Validation and Certification***—Joint work with Ingo Steinwart, Universitat Stuttgart

Abstract: We develop a methodology for the validation of simulation codes and the use of simulation codes in the certification of physical systems. This is accomplished through the development of a hypothesis testing framework which takes advantage of the customer's flexibility in the specification of performance thresholds. We provide the first solutions, as far as we know, of the extrapolation problem, namely validation or certification where the sample data come from a different regime than the deployed process.

Talk 2) ***Optimal Uncertainty Quantification***—Joint work with Houman Owhadi, Tim Sullivan, Mike McKerns, and Michael Ortiz, Caltech

Abstract: We propose a rigorous framework for Uncertainty Quantification (UQ) in which the UQ objectives and the assumptions/information set are brought to the forefront. This framework, which we call Optimal Uncertainty Quantification (OUQ), is based on the observation that, given a set of assumptions and information about the problem, there exist optimal bounds on uncertainties: these are obtained as values of well-defined optimization problems, subject to the constraints imposed by the scenarios compatible with the assumptions and information. In particular, this framework does not implicitly impose inappropriate assumptions, nor does it repudiate relevant information.

Although OUQ optimization problems are extremely large, we show that under general conditions they have finite-dimensional reductions. As an application, we develop Optimal Concentration Inequalities of Hoeffding and McDiarmid type. Surprisingly, contrary to the classical sensitivity analysis paradigm, these results show that uncertainties in input parameters do not necessarily propagate to output uncertainties.

In addition, a general algorithmic framework is developed for OUQ and is tested on the Caltech hypervelocity impact problem, suggesting the feasibility of the framework for important complex systems.

Biography: Clint Scovel received his Ph.D in Mathematics from the Courant Institute of Mathematical Sciences at New York University in 1983 and has been a technical staff member at Los Alamos National Laboratory from 1986 until the present. He has worked in Symplectic Integration Algorithms and Learning Theory. Recently he has been working to develop a theory of Validation and Certification and a framework for Uncertainty Quantification.

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